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# M O S T P L A I N E

and easie way for the finding of the

Sunnes *Amplitude* and *Azimuth*,

and thereby the Variation

of the *Compass*, by

*Logarithme.*

Written by W. B.

*Also another plaine way for the Azi-*

*muth, by the Table of Sines in five*

*seuerall Cases.*

By I. T.

*Ex Libris Publice Universitatis Glasgouensis  
Empt. Gualtero Academicum Junolibus 1692*





## Of the Variation of the Compassse.

**T**He Variation of the *Compassse*, is the difference between the true *Meridian* of the world, and the *Meridian* of the *Loadstone*, which is pointed out by the *Compassse* or *Needle*; and is for the most part variable, as you sayle to different places; But fixt and permanent being the same, alwayes in one and the same place; (although there may be difference in the touch of the *Stone*, and in the obseruations of different men)

Now for the finding of this Difference or Variation, the vsuall and most easiest way; is by taking the Sunnes *Amplitude* at rising or setting, and compared with the true; But this way serueth chiefly in all places not farre distant from the *Equinoctiall*, whose *Latitude* is not great; For if you were to sayle farre to the *South* or *North*, neere or beyond the *Arctic* or *Antarctic* *Circles*, it were of no force at all;

The other way commonly vsed, is by taking the height or *Almicuter* of the Sunne, and at the same time the *Azimuth* also, which is in vse from each *Pole* to 30. or 40. degrees of *Latitude*, and at any place where the *Sunne* doth not vsually rise and set cleere, for in diuers places you shall not see it rise or set, yet seldome but it may be seene either forenoone or afternoone: Now the working of both these wayes are found diuersly; either by *Instrument* or *Arithmeticks*: But I will heere onely shew the worke  
by

(2)

by *Logarithms*, which is the most easieſt of all *Arithmaticall* workes and firſt of the *Amplitude*.

## To finde the *Amplitude*.

**T**He *Amplitude* or bredth of the *Sunnes* riſing or ſetting from the true Eaſt or Weſt point; is found by *Sines* thus, As the ſine of the Complement of the *Latitude*, is to the ſine of the *Declination*, ſo is the *Radius* to the ſine of the *Amplitude*;

But in *Logarithme*, you are onely to looke the *Logar*: of the Complement of the *Latitude*, and the *Logar*: of the *Declination*; and ſubſtract one from the other, the remainder is the *Logarithme* of the *Amplitude*,

*Example.*

Data { Complement, *Latitude* — 40. deg. 30'. } North { I demand the  
 { *Declination* ——— 20. — 40. } { *Amplitude*?

Comp: Lat: 40. d. 30'. Loga: — 4316323

Declinat: 20. 40'. Loga: 10414836

6098513 the *Logar*: of the *Amplitude* 32. deg. 55'. and ſomewhat more.

## To finde the *Azimuth*.

**I**T is to be conſidered that in the Doctrine of *Triangles*, it is required in the ſolution of any queſtion there are three things to be given in any *Triangle*, before the queſtion can be answered, which in this for finding the true *Azimuth* of the *Sunne*; you are to know or imagine your *Latitude*, the Complement thereof is

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one side of a Triangle (which is the distance between the *Pole* and the *Zenith*) the Complement of the Sunnes *Declination* is another side of the same Triangle (which is the distance between the *Sunne* and the *Pole*) then is the Complement of the *Almicanter* the other side (which is the distance between the *Sunne* and the *Zenith*.)

Heere haue you an oblique *Spharicall Triangle* whose three sides are knowne, and it is desired to knowe the angle at the *Zenith*: whose quantitie being found is the Sunnes true distance from the *North*, (if the north *Pole* be eleuate) or the distance from the *South*, (if the south *Pole* be eleuate,) and in this question there are two cases.

### The first Case.

**T**He first is, when you are on the same side of the *Equinoctiall* the *Sunne* is on: then are the Triangle sides all lesse then *Quadrants*, and may be resolued by *Logarithme*, 2. Booke, 6. Chapter, and 8. section: As thus,

Adde halfe the base, and halfe the difference of the containing sides together; and to the *Logarithme* thereof, adde the *Loga*: of the difference of them, out of which somme, subtract the somme of the *Loga*: of the two sides, and the halfe of the remainder is the *Loga*: of an Arch, which being doubled, is the quantitie of the angle of the *Zenith*, or verticall angle.

### Example.

Data { Latitude North 51. deg 30'. }  
 { Declination North 20. 00. } I demand the *Azimuth*?  
 { Almicanter 48. 30. }

Let { P. Z. be the Complement of the Latitude — 38. d. 30'. }  
 { P. S. being the base, by the Comp. of the Declinat. 70. 00. }  
 { S. Z. by the Complement of the Almicanter — 41. 30. }  
 And let the Angle P. Z. S. be sought for —————

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(4)

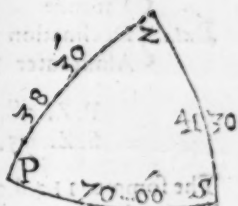
*The forme of the Worke.*

P. Z. 38.d.30'. Loga. 4739880

S. Z. 41. 30. Loga. 4115535

8855415 added.

The difference 3.d. 0'.

 $\frac{1}{2}$  Difference 1.d.30'. $\frac{1}{2}$  the base, P. Z. 35. 00.

The 2. former added 36.d.30'. Log. 5194916

The same subtract. 33. 30. Loga. 5943212

11138128

8855415

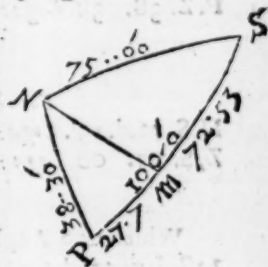
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$\frac{1}{2}$  The former 1141357 the *Logarit*: of the arch 63.deg. 8'. 30". which doubled is 126. deg. 17'. the Sunnes true distance from the North: which compared with the magneticall; the difference is the Variation.

*The second Case.*

The other Case is, when you are on the one side of the *Equinoctiall*, and the *Sunne* on the other; then is the base P. S. more then a *Quadrant*, and is to be resolved by *Logar*: 2. Booke, 6. Chapter, 10. section: Thus,

Add the differentia of  $\frac{1}{2}$  the somme of 9 legs: to the differentia of  $\frac{1}{2}$  the difference of the legs: and from the *Product* subtract the differentia of  $\frac{1}{2}$  the true base, and the remainder shall be the differentia of the alterne  $\frac{1}{2}$  base: which  $\frac{1}{2}$  alterne base added to the true  $\frac{1}{2}$  base is the greater case, M. S. also the same subtracted from the same  $\frac{1}{2}$  true base is the lesser case P. M: distinguishing two right angled *Triangles*; which doe make knowne both their owne partes, and all the parts of the Triangle proposed.



(5)

Data { Latitude 51. deg. 30'. North } Idemaund the  
 { Declination 10. 00. South } Azimuth?  
 { Almicanter 15. 00. — }

P. Z. 38. deg. 30'.

S. Z. 75. 00.

The somme 113. d. 30'.

The one halfe 56. 45.

The difference 36. 30. differentia 4221605 —

The halfe 18. 15. differentia 11094182 +

The base P. S. 100. d. 00'.

8672577 +

 $\frac{1}{2}$  Base

50. 00. differentia 1754259 —

8626836 the differentia

(of 22. d. 53'. the  $\frac{1}{2}$  alterne base.*Againe,*The  $\frac{1}{2}$  true base 50. deg. 00'.The  $\frac{1}{2}$  alterne base 22. 53.

Added 72. deg. 53'. the greater case M. S.

Subtracted 27. deg. 7'. the lesser case M. P.

*For the Triangle P, M, Z.*

P. M. 27. d. 7'. Loga: 7862605

P. Z. 38. 30. Loga: 4739880

3122725 the Loga: of the angle P, Z, M.

(47. deg. 2'. 30".

*For the Triangle M, Z, S.*

M. S. 72. d. 53'. Loga: 453035

Z, S. 75. 00. Loga: 346683

(81. deg. 40'.

106352. the Loga: of the angle, M, Z, S,

Which two Angles so found and added together, maketh  
 128. deg. 42'.  $\frac{1}{2}$ . the Sunnes true distance from the North point,  
 from which if you substraet 90. the remainder leaueth 38. d. 42'. 30"  
 the distance from the East or West demaunded.

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1. For the Sunnes Azimuth having no Declination.

**A**Dde the Complement of the *Latitude*, to the complement of the *Almicanter*, which if the totall be more then a quadrant, substraet 90. and set downe the sine of the remainer for the first number: Againe, adde the complement of the *Latitude* and the *Almicanter*, and adde the sine thereof to the former: from the one halfe of that totall substraet your first number or sine, and set downe the remainer: Then,

As the  $\frac{1}{2}$  of the 2. first numbers added is in proportion to  $\frac{1}{2}$  whole sine, so is the said remainer to the sine of the Sunnes true *Azimuth*.

*Example.*

*Latit.* 51.d.30'. the *Comple.* 38.d.30'. } Added makes 108 d. 30'.  
*Almicant.* 20.d. *Comple.* 70. 0. } 90. substraetted, leaues  
 18.deg. 30'. whose sine 3173. is the first number. Againe, complement of the *Latitude* 38.d. 30'. *Almic.* 20.d. added makes 58. 30'. whose sine 8526. is the second number, those 2. numbers added makes 11699. the  $\frac{1}{2}$  thereof 5849. from which substraet 3173. the first number rests 2676. for the remainer: then say,

As 5849. the  $\frac{1}{2}$  of the 2. first numbers is to 10000. the whole sine, so is 2676. the remainer to the *Azimuth* desired.

*Facit*, 4575. whose arch 27.d. 14'. is the *Azimuth* from the East Southward.

2. When the Sunne hath North Declination, the 2. Complements being equall to a quadrant.

**A**Dde the complement of the *Latit.* with the *Almicanter* only, and from  $\frac{1}{2}$  the sine thereof, substraet the sine of the Declination, and setting downe the remainer,

As the  $\frac{1}{2}$  aforesaid, is to the whole sine, so is the remainer aforesaid to the sine of the *Azimuth* desired.

3. When the Sunne hath North Declination, the 2. Complements lesse then a quadrant.

**A**Dde the complement of the *Latit.* and the complement of the *Almican.* setting downe the sine of the complement thereof, then

then adde the *Almicanter* and the complement of the *Latitude*, and from the sine thereof subtract the former, setting downe  $\frac{1}{2}$  of the remaine for the first found number: againe subtract the sine of the first Complement from the sine of the Declination and the remaine thereof, againe subtract from your first found number, and set the remaine thereof down for your second number: and then, As the first found is to the whole sine, so is the second to the *Azimuth* desired.

4. When the Sunne hath North Declination, and the 2. Complements more then a quadrant.

**A**Dde the complement of the *Latitude* and complement of the *Almicanter*, which being more then 90. subtract 90. and set downe the sine of the remainder, then adde the *Almicant.* and complement of the *Latit.* and set downe the sine thereof, add both the sines together and take the  $\frac{1}{2}$  thereof for the first found number, then to the sine of the first 2. complements adde the sine of the Declination, and from that totall subtract the first found, and set downe the remainder for the second found: and then,

As the first found is to the whole sine, so is the second found to the sine of the *Azimuth* desired.

5. When the Sunne hath South Declination, and the 2. Complements more then a quadrant.

**A**Dde the 2. Complements, subtract 90. set downe the sine of the remainder, adde also the *Almicanter* and complement of *Latitude*, adde both their sines and set downe  $\frac{1}{2}$  of the totall for the first found, then subtract the sine of the Declination from the sine of the remaine of the first 2. Complements, and that remaine againe from the first found, which last remaine set downe and say,

As the first found is to the whole sine, so is the second found to the sine of the *Azimuth* desired.





